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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/934,059	08/21/2001	Sujit V. Gaikwad	1100.1119101 (H0001511)	7383

7590 01/22/2004

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EXAMINER	
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ART UNIT	**PAPER NUMBER**
2121	8

DATE MAILED: 01/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

8a

Office Action Summary	Application No.	Applicant(s)	
	09/934,059	GAIKWAD ET AL.	
	Examiner	Art Unit	
	Aaron Perez-Daple	2121	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on 17 November 2003.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-27 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-27 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 5 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

1. This Action is in response to Amendment filed 11/17/03, which has been fully considered.

2. Original claims 1-27 are presented for examination.

3. This Action is made Final.

Response to Arguments

Information Disclosure Statement

4. Per Applicant's request, an additional copy of the IDS, paper number 5, has been included with this Action.

Claim Objections

5. The objection to **claim 2** is hereby withdrawn in view of Applicant's arguments, which are found persuasive.

112 Rejection of Claims

6. The rejection of **claim 2** under 35 U.S.C. 112 second paragraph is hereby withdrawn in view of Applicant's arguments, which are found persuasive. However, the Examiner notes that the interpretation of "without a model of the process" as meaning "without requiring any structural information about the process dynamics other than knowledge of whether the process is self-regulating" is consistent with the instant application. Referring to the first full paragraph of page 9 of the specification, the specification discloses that the operator must indicate whether the process is stable in nature (i.e. self-regulating) or exhibits second-order

behavior. Applicant therefore discloses that limited knowledge of the process is required. However, the Examiner finds that this limited knowledge does not constitute a model of the process. Furthermore, the distinction presented by Applicant between modeling the process and driving the process towards a "target loop transfer function" is persuasive.

7. The rejection of claims 21-24 under 35 U.S.C. 112 second paragraph is hereby withdrawn in view of Applicant's arguments, which are found persuasive.

102 Rejection of Claims

8. Applicant's arguments filed 11/17/03 have been fully considered but they are not persuasive.

9. As for **claims 1-12, 14-20 and 25-27** rejected under 35 USC 102(b) as being anticipated by Nishikawa et al ("A Method for Auto-Tuning of PID Control Parameters", Automatica, vol. 20, no. 3, pp. 321-332, 1984.) (hereinafter Nishikawa), Applicant asserts that Nishikawa fails to disclose a target loop transfer function but rather teaches only the use of a weighted integral squared error. The Examiner notes that Nishikawa teaches *minimizing* the weighted squared error. The transfer function having minimal squared error is therefore the "target loop transfer function," which falls within the scope of the broadest reasonable interpretation of the claims. Applicant is reminded that limitations from the specification may not be read into the claims. Furthermore, with reference to claims 1, 3-12, 14-20 and 25-27, it is clear that Applicant intends the scope of "towards a target loop transfer function" to include the use of a model, because otherwise claim 2 would not be further limiting. For the reasons

stated above, Nishikawa clearly anticipates all the elements of the rejected claims 1-12, 14-20 and 25-27, which are properly rejected under 35 USC 102(b).

10. As for **claims 1, 2, 7-11 and 25-27** rejected under 35 USC 102(b) as being anticipated by Wang et al ("New frequency-domain design method for PID controllers", IEE Proc.-Control Theory Appl., vol. 142, no. 4, July 1995.) (hereinafter Wang), Applicant asserts that Wang does not disclose modifying gain parameters during operation. Wang clearly teaches that the disclosed methods are used in the tuning of PID controllers [pg. 265, column 1, "The PID controller…and ease of use."]. As understood by one of ordinary skill in the art, tuning procedures are used while a controller continues to control a process. Although the simulation and calculation of the gains may, in some instances, occur "off-line" during the initial design of a PID control system, normally these calculations occur while the controller continues to control a process and are then applied after calculation and simulation (thereby completing the "tuning"). Therefore, Wang teaches this limitation of the claims.

Applicant further asserts that Wang fails to disclose the introduction of a disturbance while the controller continues to control a process. As indicated in the previous Action, paper number 6, Wang clearly discloses the introduction of a disturbance [d, Fig. 1], which one of ordinary skill in the art would recognize is applied while the controller continues to control a process. For the reasons stated above, Wang clearly anticipates all the elements of the rejected claims 1, 2, 7-11 and 25-27, which are properly rejected under 35 USC 102(b).

103 Rejection of Claims

11. Independent claim 1 was shown to be properly rejected by Wang under 35 U.S.C. 102(b). Therefore, dependent claims 13, 14, 21, and 22-24 are properly rejected under 35 U.S.C. 103(a) for the reasons presented in the previous Action, paper number 6, and repeated below.

Claim Rejections - 35 USC § 102

12. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

13. Claims 1-12, 14-20 and 25-27 are rejected under 35 U.S.C. 102(b) as being anticipated by Nishikawa et al (Nishikawa et al., "A Method for Auto-Tuning of PID Control Parameters", Automatica, vol. 20, no. 3, pp. 321-332, 1984.) (hereinafter Nishikawa).

As for claims 1 and 25, Nishikawa discloses a method and a tuning device for determining one or more new gains for a controller while the controller continues to control a process towards a target loop transfer function [Section 4.1, pgs. 325-326, "First, we summarize...without the derivate of J proposed by Zangwill (1967)."], the controller receiving a process output signal [x, Fig. 3] and a process set point signal [R, Fig. 3] and providing a process input control signal [Fig. 3], the method comprising the steps of:

introducing a disturbance into the process input control signal [pg. 323, "In contrast with these...desires to apply it."];

calculating one or more new gains for the controller using a controller output signal, the process input control signal, and the target loop transfer function [Section 3.2, pgs. 324-325, "The closed-loop procedure...is omitted here."]; and

using the one or more new gains in the controller to subsequently control the process [Section 1, pgs. 321-322, "In the last few years...gives some concluding remarks."].

14. As for claim 2, Nishikawa discloses the method of claim 1, wherein the one or more new gains for the controller are determined without using a model of the process [Section 2, "A tuning procedure...have no interaction."].

15. As for claim 3, Nishikawa discloses the method of claim 1, wherein said gains include a proportional gain [Table 4, pg. 327; Section 4.3, pgs. 326-328, "To overcome the...for the PID control."].

16. As for claim 4, Nishikawa discloses the method of claim 1, wherein said gains include an integral gain [Table 4, pg. 327; Section 4.3, pgs. 326-328, "To overcome the...for the PID control."].

17. As for claim 5, Nishikawa discloses the method of claim 1, wherein said gains include a derivative gain [Table 4, pg. 327; Section 4.3, pgs. 326-328, "To overcome the...for the PID control."].

18. As for claim 6, Nishikawa discloses the method of claim 1, wherein the target loop transfer function is indicative of a desired response of the process [Section 4.1, pgs. 325-326, "First, we summarize...without the derivate of J proposed by Zangwill (1967)."].

19. As for claim 7, Nishikawa discloses the method of claim 6, wherein the target loop transfer function is a first-order transfer function [Section 2, "A tuning procedure...because the actions of P, I and D have no interaction."].

20. As for claim 8, Nishikawa discloses the method of claim 6, wherein the target loop transfer function is a second-order transfer function [Section 2, "A tuning procedure...because the actions of P, I and D have no interaction."; Section 4.2, "Let us examine...the control of real processes."]

21. As for claim 9, Nishikawa discloses the method of claim 1, wherein the process is controlled within a desired closed-loop control bandwidth [Section 3.2, pgs. 324-325, "The closed-loop procedure...is omitted here."].

22. As for claim 10, Nishikawa discloses the method of claim 9, wherein the desired closed-loop control bandwidth is indicative of a desired settling time for the process [Fig. 4, Section 3.2, pgs. 324-325, "The closed-loop procedure...is omitted here."].

23. As for claim 11, Nishikawa discloses the method of claim 9, wherein the desired closed-loop control bandwidth is indicative of a time constant for the process [Fig. 4, Section 3.2, pgs. 324-325, "The closed-loop procedure...is omitted here."].

24. As for claim 12, Nishikawa discloses the method of claim 1, wherein the disturbance includes one or more step changes [pg. 324, "Figure 3 shows a block diagram...of x(t) and y(t), respectively."].

25. As for claim 14, Nishikawa discloses the method of claim 1, wherein the disturbance includes a white noise signal that is band-pass filtered and clipped [N, Fig. 1].

26. As for claim 15, Nishikawa discloses the method of claim 1, wherein the disturbance is introduced into the controller output signal causing a response in the process input control signal [Fig. 3; pg. 324, "Figure 3 shows a block diagram...of x(t) and y(t), respectively."].

27. As for claim 16, Nishikawa discloses the method of claim 1, wherein the controller uses one or more new gains to produce the controller output signal [Table 4, pg. 327; Section 4.3, pgs. 326-328, "To overcome the...for the PID control."].

28. As for claim 17, Nishikawa discloses the method of claim 16, wherein the controller output signal comprises a proportional error [pg. 327; Section 4.3, pgs. 326-328, "To overcome the...for the PID control."].

29. As for claim 18, Nishikawa discloses the method of claim 16, wherein the controller output signal comprises an integral error [Table 4, pg. 327; Section 4.3, pgs. 326-328, "To overcome the...for the PID control."].

30. As for claim 19, Nishikawa discloses the method of claim 16, wherein the controller output signal comprises a derivative error [Table 4, pg. 327; Section 4.3, pgs. 326-328, "To overcome the...for the PID control."].

31. As for claim 20, Nishikawa discloses the method of claim 1, wherein the process input control signal is the sum of the controller output and the disturbance [Fig. 3; pg. 324, "Figure 3 shows a block diagram...of x(t) and y(t), respectively."].

32. As for claims 26 and 27, Nishikawa discloses a method and a tuning device for determining one or more new gains for a controller while the controller continues to control a process towards a target loop transfer function [Section 4.1, pgs. 325-326, "First, we summarize...without the derivate of J proposed by Zangwill (1967)."], the controller

receiving a process output signal [x, Fig. 3] and a process set point signal [R, Fig. 3] and providing a controller output signal [y, Fig. 3], the method comprising the steps of:

introducing a disturbance into the controller output signal causing a response in a process input control signal [pg. 323, "In contrast with these...desires to apply it."];

calculating one or more new gains for the controller using the controller output signal, the response in the process input control signal, and the target loop transfer function [Section 3.2, pgs. 324-325, "The closed-loop procedure...is omitted here."]; and

using the one or more new gains in the controller to subsequently control the process [Section 1, pgs. 321-322, "In the last few years...gives some concluding remarks."].

33. Claims 1, 2, 7-11 and 25-27 are rejected under 35 U.S.C. 102(b) as being anticipated by Wang et al (Wang et al., "New frequency-domain design method for PID controllers", IEE Proc.-Control Theory Appl., vol. 142, no. 4, July 1995.) (hereinafter Wang).

As for claims 1 and 25, Wang discloses a method and a tuning device for determining one or more new gains for a controller while the controller continues to control a process towards a target loop transfer function [Section 3.1, "Our objective is...guaranteed to be small."], the controller receiving a process output signal [y, Fig. 1] and a process set point signal [r, Fig. 1] and providing a process input control signal [Fig. 1], the method comprising the steps of:

introducing a disturbance into the process input control signal [d, Fig. 1];

calculating one or more new gains for the controller using a controller output signal, the process input control signal, and the target loop transfer function [Section 3.1, "Our objective is...guaranteed to be small."]; and

using the one or more new gains in the controller to subsequently control the process [Section 3.1, "Our objective is...guaranteed to be small."].

34. As for claim 2, Wang discloses the method of claim 1, wherein the one or more new gains for the controller are determined without using a model of the process [Section 1, "From our point of view...found in the literature."]

35. As for claim 7, Wang discloses the method of claim 6, wherein the target loop transfer function is a first-order transfer function [Section 2, "One of the most common...via $\tau=T/\alpha$."].

36. As for claim 8, Wang discloses the method of claim 6, wherein the target loop transfer function is a second-order transfer function [Section 2, "One of the most common...via $\tau=T/\alpha$."].

37. As for claim 9, Wang discloses the method of claim 1, wherein the process is controlled within a desired closed-loop control bandwidth [Section 2.2, "Suppose that the process...response in the control signal."].

38. As for claim 10, Wang discloses the method of claim 9, wherein the desired closed-loop control bandwidth is indicative of a desired settling time for the process [Section 3.2, "It is known that...assumed to be known."].

39. As for claim 11, Wang discloses the method of claim 9, wherein the desired closed-loop control bandwidth is indicative of a time constant for the process [Section 3.2, "It is known that...assumed to be known."].

40. As for claims 26 and 27, Wang discloses a method and a tuning device for determining one or more new gains for a controller while the controller continues to control a process

towards a target loop transfer function [Section 3.1, "Our objective is...guaranteed to be small."], the controller receiving a process output signal [y, Fig. 1] and a process set point signal [r, Fig. 1] and providing a controller output signal [Fig. 1], the method comprising the steps of:

introducing a disturbance into the controller output signal causing a response in a process input control signal [d, Fig. 1];

calculating one or more new gains for the controller using the controller output signal, the response in the process input control signal, and the target loop transfer function [Section 3.1, "Our objective is...guaranteed to be small."]; and

using the one or more new gains in the controller to subsequently control the process [Section 3.1, "Our objective is...guaranteed to be small."].

Claim Rejections - 35 USC § 103

41. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

42. Claim 13 is rejected under 35 U.S.C. 103(a) as being obvious over Wang in view of Stoddard et al (US 5,895,596) (hereinafter Stoddard). Although obvious to one of ordinary skill in the art, Wang does not specifically teach the use of a disturbance comprising a pseudo random binary sequence. However, Stoddard teaches the use of a disturbance comprising a

pseudo random binary sequence [cols. 8-9, In a characterization control…implemented in statespace form."].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Wang by using a pseudo random binary sequence as the disturbance in order to allow for reliable identification of control parameters in a thermal reactor and for design simplicity, as taught by Stoddard [cols. 10-11, "The identification or characterization…outputs are measured."].

43. Claims 13 is rejected under 35 U.S.C. 103(a) as being obvious over Wang in view of Grassi (E. Grassi, "Proportional-Integral-Derivative Controller Tuning by Frequency Loop-Shaping," Ph.D. dissertation, Arizona State University, December 1999.) (hereinafter Grassi).

Wang does not specifically teach the use of a disturbance comprising a pseudo random binary sequence. However, Grassi teaches the use of a disturbance comprising a pseudo random binary sequence [pgs. 29-30, "Good input signal…drift in the output occurs."].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Wang by using a pseudo random binary sequence as the disturbance in order to provide the excitation required to tune the controller parameters, as taught by Grassi [pgs. 29-30, "Good input signal…drift in the output occurs."].

44. Claim 14 is rejected under 35 U.S.C. 103(a) as being obvious over Wang in view of Ho et al (US 5,587,899) (hereinafter Ho). Although obvious to one of ordinary skill in the art, Wang does not specifically teach the use of a disturbance comprising a white noise signal

that is band-pass filtered and clipped. However, Ho discloses the use of a band-pass clipped white noise signal [col. 8, "However, if a set point...impulse signal, or white noise."].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Wang by using a white noise signal that is band-pass filtered and clipped as the disturbance in order to measure and tune the system response to noise similar to what may occur during system operation.

45. Claim 21 is rejected under 35 U.S.C. 103(a) as being obvious over Wang in view of Grassi et al (Grassi et al, "PID Controller Tuning by Frequency Loop-Shaping," Proc. 35th Conference on Decision and Control, Japan, December 1996.) (hereinafter Grassi II).

As for claim 21, although obvious to one of ordinary skill in the art, Wang does not specifically teach minimization of applicant's equation 6. However, Grassi II teaches the minimization of an equivalent expression to applicant's equation 6 [Section 2.3, "The tuning of the...with a suitable initialization."].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Wang by minimizing an expression for the error between the desired closed loop response and actual closed loop response, such as applicant's equation 6, in order to find an optimal tuning of the controller gains, as taught by Grassi II [Section 2.3, "The tuning of the...with a suitable initialization."].

46. Claims 22-24 are rejected under 35 U.S.C. 103(a) as being obvious over Wang in view of Grassi II and in further view of Nishikawa.

As for claim 22, although obvious to one of ordinary skill in the art, Wang and Grassi II do not specifically teach the use of a recursive least squares technique. However, Nishikawa

discloses the use of a recursive least squares technique [Sections 4.1-4.3, "First, we summarize...for the PID control."].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Wang and Grassi II by using a recursive least squares technique to minimize the error between the desired closed loop response and actual closed loop response, as taught by Nishikawa [Sections 4.1-4.3, "First, we summarize...for the PID control."].

47. As for claim 23, Wang and Grassi II do not specifically teach the method of claim 21, wherein the sum total is minimized by curve fitting said sum total using recursive least squares techniques. However, Nishikawa teaches a method similar to claim 21, wherein the sum total is minimized by curve fitting said sum total using recursive least squares techniques [Sections 4.1-4.3, "First, we summarize...for the PID control."].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Wang and Grassi II to minimize an expression for the error (e.g. the sum total) by curve fitting using a recursive least squares technique, as taught by Nishikawa [Sections 4.1-4.3, "First, we summarize...for the PID control."].

48. As for claim 24, Wang and Grassi II do not specifically teach the method of claim 23 wherein the least squares technique constraint comprises positive values for the one or more new gains for the controller. However Nishikawa teaches a method similar to that of claim 23 wherein the least squares technique constraint comprises positive values for the one or more new gains for the controller [Sections 4.1-4.3, "First, we summarize...for the PID control."].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Wang and Grassi II by using a least squares technique constraint comprising positive values for one or more new gains for the controller, as taught by Nishikawa, because positive gains are often required to optimize the system response.

Conclusion

49. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

50. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Aaron Perez-Daple whose telephone number is 703-305-4897. The examiner can normally be reached on 9am - 6pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Anil Khatri can be reached on 703-305-0282. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-4700.

1/15/04

Aaron Perez-Daple

ANIL KHATRI
SUPERVISORY PATENT EXAMINER